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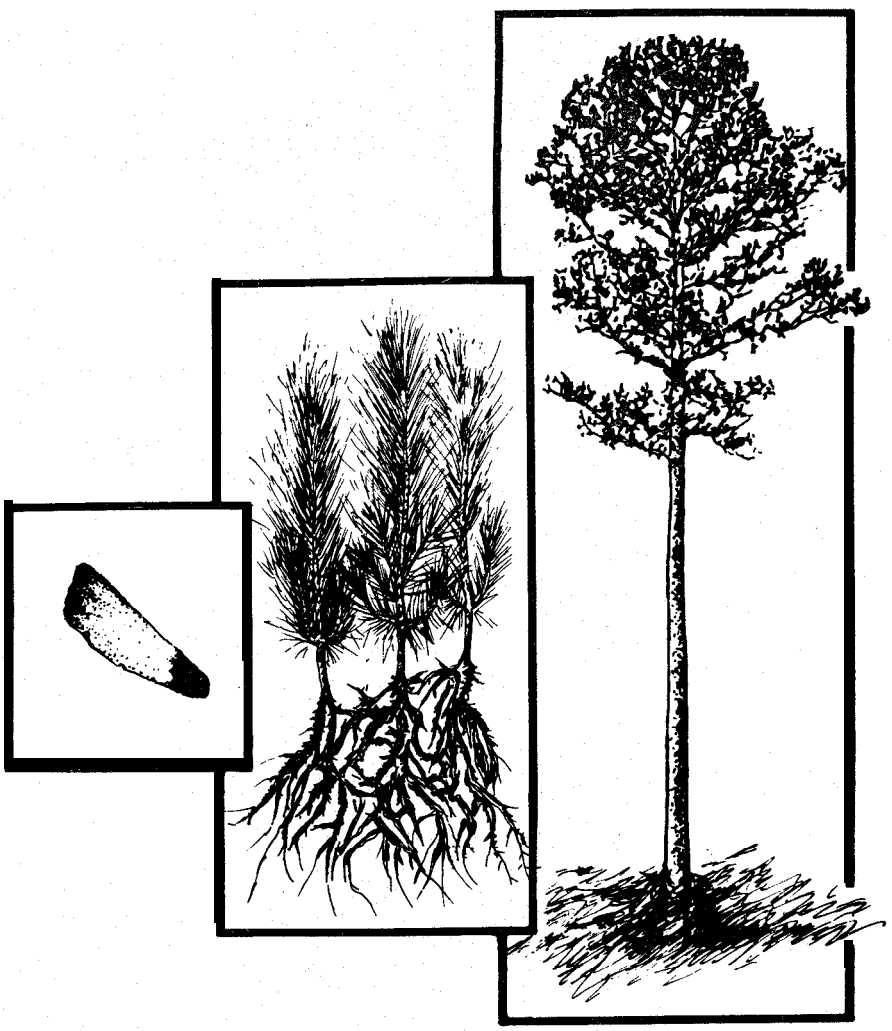
A Loblolly Pine
Management Guide

Natural Regeneration of Loblolly Pine

M. Boyd Edwards



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Acknowledgment

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ABSTRACT

For many landowners, low cost makes natural regeneration an attractive alternative to planting when loblolly pine stands are harvested. Clearcutting, seed-tree, shelterwood, and selection methods can be used. Keys to success are a suitable seedbed, an adequate seed supply, sufficient moisture, and freedom from excessive competition.

Keywords: *Pinus taeda*, silvicultural systems, clearcutting, shelterwood, seed tree, selection cutting.

Loblolly pine (*Pinus taeda* L.) became the most important timber species in the Southern United States primarily by seeding naturally onto abandoned cropland. It is now the dominant species on more than 31 million acres or 17 percent of the South's timberland, and its rapid growth and good form-make it an ideal choice for far more acres. In efforts to maintain the species, however, foresters have largely abandoned natural methods for reproducing stands in favor of plantation forestry. These efforts probably will always be less than fully successful because not all landowners favor to plantations.

If wood and dollar yields from loblolly pine plantations are high, so are the costs of plantation forestry. Site preparation and replanting cost from $50 to $175 per acre. On a 40-acre tract, that's the price of a new pickup truck invested in something that will take 20 years or more to pay off. In addition to high cost, there is the appearance. Some people do not like their trees in neat rows.

The best course for many landowners who are planning to harvest mature loblolly pine stands is some form of natural regeneration. This Guide is meant for the forester who is helping landowners to reproduce loblolly pine by natural means. It is a refresher course for foresters who are accustomed to plantation management.

Pros and Cons

When compared with clearcutting, site preparation, and planting, natural regeneration systems offer a number of advantages:

- Low cost, ranging from $3 to $40 per acre
- Less labor and heavy-equipment requirements
- Adaptation of native stock to the site
- Less risk of insect and disease losses
- Less soil movement
- Better appearance

These advantages are gained at some cost. On its own land, forest industry relies almost exclusively on planting for reproducing pine stands for very good reasons:

- Maximum yields
- Shortest possible rotations
- Introduction of genetically improved stock
- Lower risk of failure
- Greater control over tree spacing
- Excellent returns on investment

Before natural regeneration is recommended, a landowner should know what is being given up and what risks are being accepted. Yields are not as great and rotations are usually longer with natural stands than with plantations. The growth of the genetically improved seedlings in plantations is likely to be 10 to 15 percent faster than the growth of unimproved seedlings under the same conditions, and the difference will be even larger for unimproved seedlings in natural stands. If a drought occurs soon after seeds germinate, most of the seedlings may die and a poorly stocked stand may result. If the weather is very favorable and the seed crop was large, the new stand may be excessively dense and precommercial thinning may be necessary.

Necessary Conditions

With proper precautions, the probability of success in naturally regenerating loblolly pine is quite high. It is not the dominant species on 31 million acres by accident. It is an aggressive colonizer of recently disturbed sites, and its resistance to fire damange makes loblolly pine a subclimax species in natural southern environments where lighting fires are common. On the Coastal Plain, loblolly pine forests can be maintained indefinitely in the face of invading hardwoods by use of prescribed fires, which weaken or kill the hardwoods without damaging the pines.

In the absence of fire, hardwoods eventually replace loblolly pine, which is less able to compete for sunlight, moisture, and nutrients. Hardwoods thrive in the understories of unburned pine stands, and they. become increasingly prominent as the pine overstory matures. When the pines are harvested, these hardwoods will dominate the new stand. If the hardwoods are cut, they will sprout prolifically. There is a good case, therefore, for controlling hardwoods in loblolly pine stands.

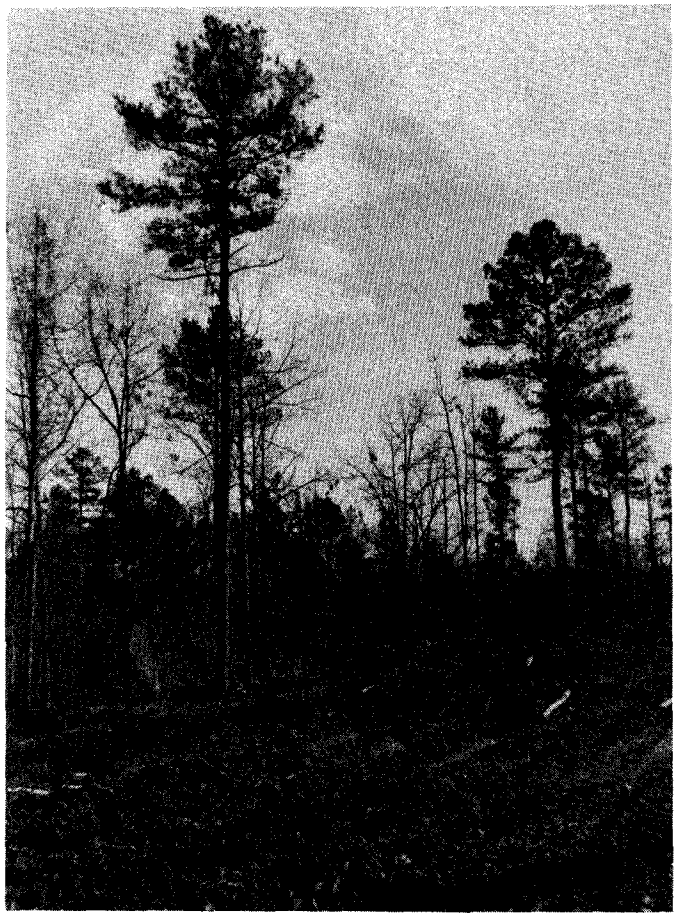
Successful regeneration of loblolly pine from seeds depends on four critical conditions:

1. A suitable seedbed
2. An adequate supply of seeds
3. Sufficient moisture for seed germination and seedling establishment
4. Freedom from excessive competition

If these conditions are met, a satisfactory new stand will almost certainly develop.

Suitable Seedbeds

Disturbance is the key to preparation of a suitable seedbed. Forest soils normally have a thick top layer of litter and organic matter, but loblolly pine seed germination is best on mineral soil. The litter and organic matter must be eliminated or moved aside to favor seed germination.



A good seedbed and a source of seeds are necessary for natural regeneration of loblolly pine.

The most practical way to get rid of litter is by burning it. Pushing it aside requires heavy equipment, and when the litter and organic matter are moved, so are the important nutrients they contain. Burning releases some nutrients to the atmosphere, but most remain to nourish a new stand.

Seedbed preparation for natural regeneration should begin several years before timber is harvested. Two or more annual prescribed burns before the harvest will create a highly satisfactory seedbed, and they will kill or weaken potential hardwood competitors. The efficacy

of burning after the harvest depends upon the regeneration system that is chosen.

The timber for burning is important because large hardwood stems are most likely to be controlled by a prescribed summer burn. Although summer burns require higher relative humidity, they are very effective in controlling hardwoods. The rule to remember for natural regeneration is to burn 3 to 4 weeks prior to seedfall in order to get the maximum benefit from a single burn. However, if you chose to burn in winter, remember that favorable weather conditions usually follow the passing of a cold front when relative humidity ranges from 20 to 40 percent and the wind is steady at 1 to 5 miles per hour.

Adequate Seed Supply

Like those of many species, the seed crops of loblolly pine vary widely from year to year. The size of the crop depends upon weather conditions and insect and disease attacks during the 14 months it takes for flowers to be fertilized and for cones and seeds to develop. Seed production also varies directly with tree vigor.

On the Coastal Plain, loblolly pine seed production is adequate for natural reproduction in most years. On the Piedmont Plateau, production is not as heavy, but enough seeds are produced for natural regeneration every 3 to 5 years. A minimum of about 50,000 seeds per acre are required to obtain adequate stocking on a burned seedbed. With a bumper seed crop, individual trees may produce that many seeds, but the effective dispersal from a single tree is only about 200 feet. The number of seeds needed for adequate stocking increases rapidly as the amount of litter increases. Excess litter should be removed by burning. Also, soils with heavy texture are better for germination than soils of lighter texture.

Loblolly pine cones open in October, and seeds are dispersed until the following March, but most

seeds are on the ground by mid-December. Very large numbers of seeds are required because they are a favorite food of birds and rodents during months between seedfall and germination.

Depending on the method of regeneration chosen, it may be necessary to estimate the size of the seed crop in the year of the harvest. With the aid of binoculars, the numbers of cones in sample trees can be counted and an estimation made to account for the ones that are not visible from the ground. The total can be multiplied by 45, the average number of sound seeds in a typical loblolly pine cone.

Adequate Soil Moisture

Little can be done to influence the supply of moisture for germination and seedling establishment, but you should know that variations in moisture supply are the main causes for variable results with natural regeneration systems. A combination of moisture and warming temperature is required for loblolly pine seeds to germinate. The proper conditions usually are present about April, but the time of germination varies from year to year and place to place. An unusually cold spring usually reduces germination.

After germination, adequate soil moisture is critical, until the seedling gets its roots well down into the soil. A drought between April and June can kill many seedlings. Fortunately, spring rains usually satisfy this moisture requirement throughout the range of loblolly pine. A drought during the summer after germination also is likely to cause high seedling mortality.

In planning for natural regeneration, foresters typically worry most about failing to get adequate stocking. They strive to obtain adequate stocking, even if a moderate drought occurs. The 50,000 seeds per acre recommended here are enough to obtain 1,000 well-spaced seedlings when the weather is somewhat unfavorable. When the moisture supply is adequate throughout the spring and

summer after germination, however, you may find that you have 20,000 instead of 1,000 seedlings per acre. Overstocking in good years is inevitable if you are to have adequate stocking in average to poor years.

Control of Competition

Loblolly pine is classed as intolerant of shading. Although it may survive, it will not thrive in the shade of competitors. It is considerably less tolerant of shade than its hardwood competitors. but loblolly pine will outgrow most of them if it is taller than they are at age 3. Thus, control of hardwood competition is crucial when stands are being reproduced.

Prescribed burning will kill hardwood stems under 3 inches *in* diameter. Many hardwood rootstocks survive one or two such burns and produce new sprouts, but repeated burning will kill them or weaken them greatly. In this respect, burning during the growing season is usually more effective than burning in the dormant season. In either case, however, hardwood stems over 3 inches in diameter are not likely to be killed by the low-intensity prescribed burns that are safe under pine overstories. Unless the owner wants some large oaks or other hardwoods for mast production, large hardwood stems should be cut or deadened with chemicals. You may be able to find a firewood cutter who will get these trees out of the way free.

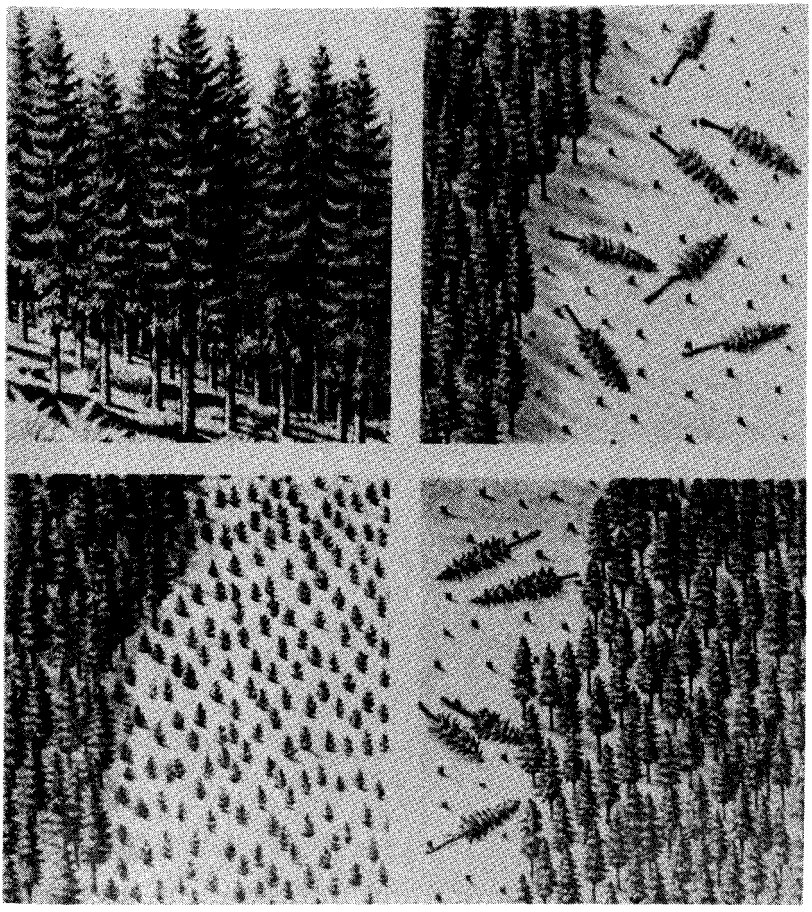
A combination of prescribed burning and hardwood tree elimination will give the young seedlings a competition-free start in life. Thereafter, periodic prescribed burning will keep hardwoods from getting a foothold in the understory. Control of hardwood competition throughout the life of the stand will enhance loblolly pine yields by 20 to 40 percent.

Silvicultural Systems

The most common silvicultural systems for regeneration of loblolly pine are clearcutting, seed tree, shelterwood, and group selection. The choice of a system should be based on stand conditions and the desires of the owner.

Clearcutting

This system involves removal of the entire forest canopy from a stand in a single harvest operation. There are several types of clearcuts, which differ in the source and condition of material that will become the new stand.



Regeneration by clearcutting.

Windblown seeds from surrounding stands often regenerate stands after clearcutting. Several conditions should be met if this source is to be used. First, the surrounding stands should contain high-quality loblolly pines of seed-bearing age. Poor-quality trees often have poor-quality offspring. Second, the cutting area must be designed so that all points in it are within 200 feet of a seed tree. Common shapes include small blocks and long, narrow strips.

Seeds or seedlings in place can be used to regenerate much larger areas. In both cases, the seeds for reproduction are obtained from the stand that is to be harvested. A good seedbed is prepared by the methods already described. In a year with adequate seed production, the stand is harvested sometime after the seeds have fallen. In the seed-in-place method, harvesting is done from November through March, after the seeds have fallen but before they have germinated. In the seedlings-in-place method, harvesting is delayed until late summer in the year after a good seed crop. By that time, the seedlings have become established, so great care is required in logging to minimize damage to the new stand. Tree-length logging severely damages the young seedlings; harvested trees must therefore be cut into log lengths before they are skidded.

Distinct advantages to clearcutting over other methods of natural regeneration of loblolly pine are:

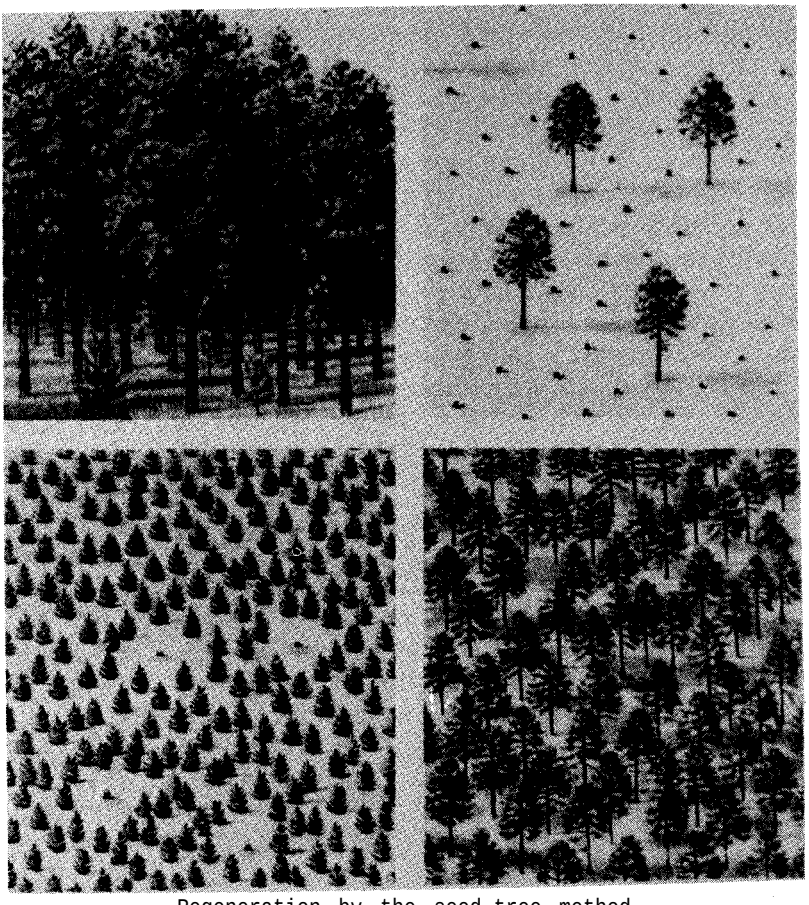
- Harvesting costs are minimized by taking the whole stand in a single operation.
- Loss of seed trees to wind damage is avoided.
- The new crop of seedlings develops in full light and free from root competition from the old stand.
- Regeneration is confined to a small portion of the rotation.

The disadvantages are:

- Competition from weeds and shrubs is usually heavy.
- The site is exposed to wind and rain.
- With seeds or seedlings in place, logging slash cannot be burned: thus, the fire danger is high.
- With seeds or seedlings in place, there is no natural seed source if drought kills the first crop of seedlings.
- Treated areas often are visually unattractive.
- merchantable material can be harvested from the new stand for 12 to 20 years after regeneration.
- There is no control over the trees from which seeds for regeneration are obtained.

Seed-Tree Method

In the seed-tree regeneration method, all but 6 to 12 evenly spaced trees per acre are harvested in a single cutting. Since the trees that remain will be the seed source for regenerating the stand, 'only individuals with desirable characteristics should be chosen. The seed trees should have deep, strong root systems and wide crowns, and they should be vigorous and free of disease. The seedbed should be prepared prior to the initial harvest, but the logging slash can be burned with seed trees standing if care is exercised to prevent damage to those trees. The seed trees should be removed 3 to 5 years after the initial harvest, when reproduction has become established. If their removal is delayed, the new stand may be severely damaged when they are cut.



Regeneration by the seed-tree method.

Some advantages of the seed-tree method are:

- Large areas can be harvested in a single operation.
- Initial regeneration costs are lower than for clearcutting and planting.
- Seeds from adjacent stands are not relied upon, and the best trees in the stand can be selected as seed sources.
- If bad weather or fire delays regeneration, the seed source remains to regenerate the area.

Some disadvantages of the seed-tree method for obtaining natural regeneration are:

- The seed trees, which are among the best trees in the stand, may be damaged by wind, lightning, or disease.
- As with clearcuts, most of the area is exposed and subject to soil erosion.
- Particularly if they have been damaged, the seed trees may be difficult to sell after seedlings are established.

Shelterwood Method

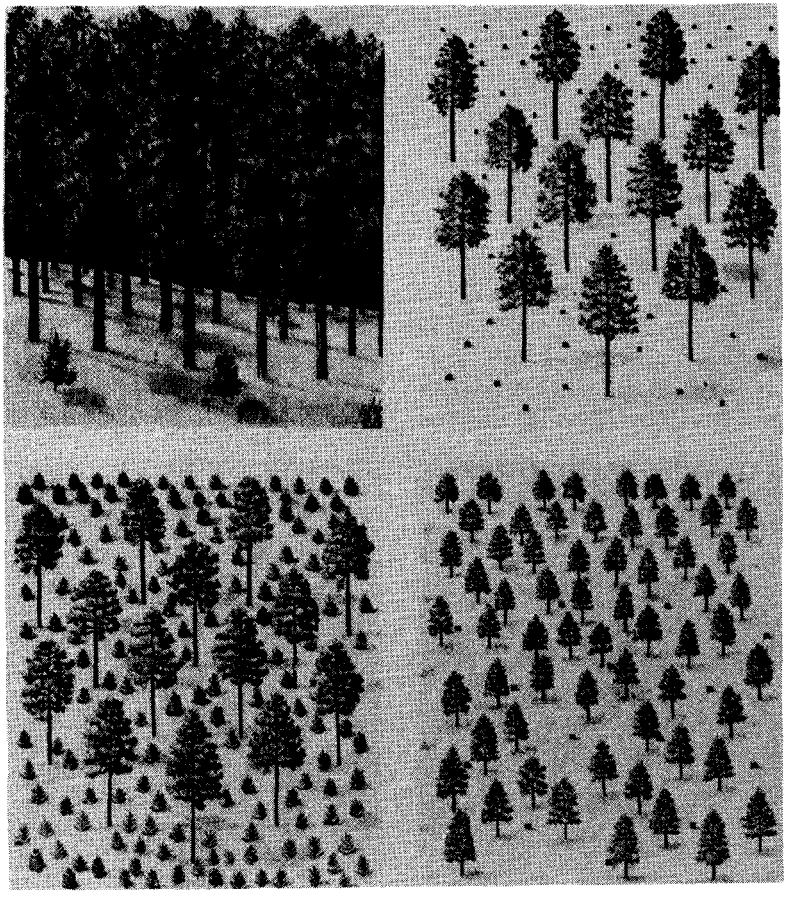
A third method for obtaining even-aged new stands of loblolly pine is the shelterwood system, in which a relatively large number of trees (20 to 40 per acre) are left in the initial harvest. The seed-bearing trees should contain 25 to 40 square feet of basal area per acre.

This rather large number of trees provides a dependable seed supply as well as a large amount of protection for the site and the new stand. In all but the poorest seed years, the shelterwood system provides enough seeds to reproduce the stand. This reliable seed supply is a big asset on some Piedmont sites where good seed years are rare. On poorly drained sites on the Lower Coastal Plain where a rising water table after a harvest cut may prevent seedling establishment and development, leaving about 35 square feet of shelterwood basal area is quite beneficial. The trees that are left will keep the water table down while the new stand is getting started. Also, the shade provided greatly suppresses competing hardwood species.

A two-cut shelterwood system--removing an entire stand in two cuts--is recommended for loblolly pine. After healthy seedlings are adequately established in 3 to 5 years, the entire sheltering overstory should be removed. If you wait much longer, the young trees will be brittle,

and the felling of the large trees will cause great damage. If the density of the new stand exceeds 1,500 stems per acre, however, killing some of the young trees is beneficial. Pre-commercial thinning can be accomplished by skidding logs through areas of dense reproduction.

It is a good practice to inject large, unwanted hardwood stems before or soon after the harvest cut. When the trees in the new stand reach a height of 18 feet at about age 10, a low-intensity prescribed burn will not hurt the pines, and a burning program to prevent hardwood encroachment can begin.



Regeneration by the shelterwood method.

Advantages of shelterwood cutting are:

- Large quantities of well-distributed seeds are provided.
- There is less need for slash disposal than with the clearcutting or seed-tree methods.
- The overwood reduces early competition from hardwoods.
- The site is well protected and has a better appearance than after the clearcutting or seed-tree methods.

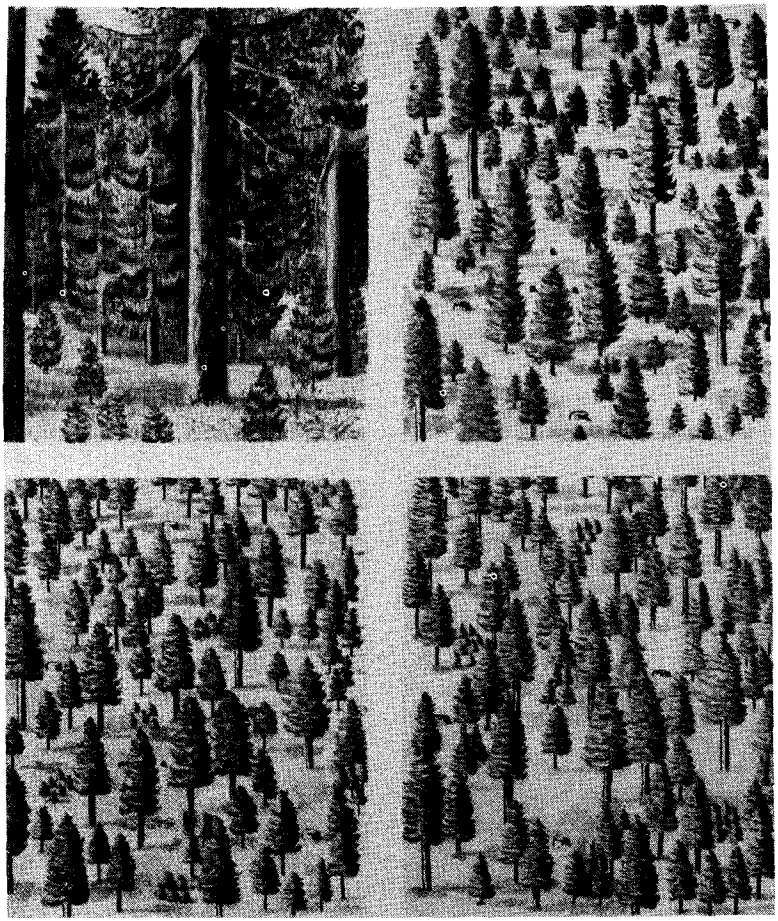
Disadvantages of the shelterwood method are:

- Reproduction may be heavily damaged when' the overwood is harvested.
- The new stand may be overly dense and require precommercial thinning.
- The overwood will slow the height growth of the pine seedlings until it is removed.
- Since the bulk of the harvest is not taken in a single cutting, the economic return from the harvest will be lower than with clearcutting.

Selection Method

The selection method of natural regeneration creates stands in which trees of all ages from seedlings to mature trees are present at the same time. A target diameter distribution for the stand is established, and trees of various sizes are cut in each harvest operation to achieve the desired diameter distribution.

Some form of selection cutting may be appropriate when the management objective is to maintain an uneven-aged stand with seedlings, saplings, pulpwood-size trees, and sawtimber-size



Regeneration by the selection method (not generally recommended for use with loblolly pine).

trees present at all times. In general, however, this method requires great skill to apply properly. Furthermore, the costs associated with frequent light cutting are high for the amounts of timber removed. For these and other reasons, selective cutting of southern pines should be approached with caution.

Group selection can work well with loblolly pine. With this method, groups of trees rather than single trees are removed from the oldest age class to create openings for reproduction. The openings that are created probably should cover at least 1.0 acre to permit adequate development of young trees. Even with group rather than **single-**

tree selection, however, major monetary sacrifices make selection cutting unattractive to most landowners.

Reproduce Pine

One of the largest problems in southern forestry is the failure of many landowners to even attempt to get pine regeneration when they harvest their pine stands. One reason for this failure may be an excessive emphasis that professional foresters place on planting of genetically improved stock. For a variety of reasons, many landowners spurn the opportunities for high returns from loblolly pine plantations, That does not mean that these owners cannot or will not grow loblolly pine.

This Guide describes silvicultural systems for natural regeneration of loblolly pine. Within these systems are alternatives that will permit a landowner to grow some pine while satisfying other goals, including attractive appearance. The Guide suggests that old hardwood trees be injected with herbicides to make room for pines. If an owner wants some den trees for squirrels or birds, however, there is no harm in leaving some old campaigners and growing pines between them.

Loblolly pine is a flexible species. Foresters must be equally flexible in prescribing treatments that regenerate loblolly pine in ways that please individual landowners.

Recommended Reading

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